

REMARKS

Upon entry of the present Amendment-E, the pending claims in the application are claims 1-9 and 32-34, of which claims 1, 5 and 8 are independent. Claims 1, 5-6, 8 and 32 have been amended by the present Amendment-E. New claims 35-36 have been added.

The above-identified Office Action has been reviewed, the objections and rejections carefully considered, and the Examiner's comments carefully weighed. In view thereof, the present Amendment-E is submitted.

It is contended that by the present Amendment-E, all bases of objections and rejections set forth in the Office Action have been traversed and overcome. Accordingly, reconsideration and withdrawal of the objections and rejections is respectfully requested.

Interview with the Examiner

Initially, applicant thanks the Examiner for the helpful and courteous telephonic interview she conducted with applicant's representative on October 21, 2009, in conjunction with Office Action of July 24, 2009. Prior to the interview, applicant's representative sent, via facsimile, an informal draft of proposed response to the Office Action, including claim amendments and arguments detailing patentably distinct features of the claimed invention, to the Examiner, and requested the Examiner to review the same.

During the interview, the Examiner informed applicant's representative that she has reviewed the draft of proposed response and claim amendments, and that proposed claim amendments overcome rejection of claim 32 under 35 USC §112. However, the Examiner informed applicant's representative that the proposed claim amendments, in her view, may not overcome the art-based rejection of claims.

Applicant's representative argued that, for example, in relation to claim 1, the proposed

combination of Colligan and Knauth fail to disclose the method step of gripping the protrusions by a gripping mechanism such that the fingers of the protrusions are maintained in abutment along said joining direction. However, according to the Examiner's view, such method step is taught by Knauth. Applicant respectfully disagrees with the Examiner's interpretation of Knauth because teachings of Knauth cannot be applied for gripping the protrusions, as discussed below.

Further, it was discussed that, pending further search and review, amending claim 5 by replacing the term "plunging member" with the term, -- probe --, may distinguish claims 5-7 and 33 over the disclosure of Colligan and Boon. However, no agreement was reached.

Amendments Presented

In the Claims: claim 1 has been amended by specifying that a method of manufacturing a hollow cylindrical body includes the step of bending a plate material to have a substantially hollow cylindrical shape with end faces of the plate material opposing each other along a joining direction; bringing end faces of the plate material into abutment against each other along the joining direction; the plate material having fingers projecting from corners along the joining direction, and pairs of said fingers form protrusions projecting along the joining direction at opposite end of the hollow cylindrical shape; gripping said protrusions by a gripping mechanism such that the fingers of said protrusions are maintained in abutment along said joining direction; and removing said first and second protrusions.

Claim 5 has been amended by specifying that a friction stir welding process for joining first and second ends of a metal workpiece together, includes: bringing a first end face and a second end face respectively on the first and second ends of the metal workpiece into abutment against each other; and thereafter joining said first end face and said second end face to each other along a boundary line where the end faces abut with a rotating friction stir welding tool

having a probe with a substantially circular cross section on a tip end thereof; and that the first end is present on a retreating side relative to a rotating direction of said probe and the second end is present on an advancing side relative to the rotating direction of said probe; that the probe is plunged with a central region thereof being displaced from said boundary line to said second end by a predetermined distance; and that a rotational axis of said probe extends substantially parallel to a plane between said first and second end faces where said faces are brought into abutment with each other.

Claim 8 has been amended by specifying that a friction stir welding process for joining first and second ends of a metal workpiece together, includes: bending the metal workpiece to have a curved shape; bringing a first end face and a second end face respectively on the first and second ends of the metal workpiece having the curved shape into abutment against each other to form abutting regions; and then friction-stir-welding the abutting regions to join said end faces to each other using a rotating friction stir welding tool having a probe on a tip end thereof; that the first end face and said second end face have sags extending in a direction transverse to said thickness direction; that when said abutting regions are formed, said sags of said first end face and said second end face are disposed in confronting relation to each other and positioned outwardly of an outer circumferential surface of said curved shape; that the burrs are positioned inwardly of an inner circumferential surface of said curved shape; that said outer circumferential surface is longer than the inner circumferential surface; and that when the abutting regions are friction-stir-welded, said rotating plunging member is plunged into the outer circumferential surface on which said sags are disposed in confronting relation to each other and thereafter moved in a joining direction along the abutment between the end faces to scan said abutting regions.

Claim 32 has been amended by specifying that the step of said friction-stir-welding involves use of a friction stir welding tool having a probe on a tip end thereof; that said probe is

plunged into portions of the plate material around said end faces thereof and moved in the joining direction along the abutment between the end faces; said rotating plunging member having a substantially circular cross section; and that said probe is displaced from a boundary line between said end faces in a circumferential direction of said hollow cylindrical body by a predetermined distance.

New claim 35-36 have been added by the present amendment. New claim 35 defines additional aspects of claim 1; and claim 36 defines additional aspects of claim 5.

Applicant respectfully submits that the above amendments, including new claims, are fully supported by the original disclosure including drawings. Applicant also respectfully submits that no new matter is introduced into the application by amending the claims, and by adding new claims, since the entire subject matter thereof was expressly or inherently disclosed in the original claims, specification and the drawings.

Claim Rejections – 35 USC §112

1. In the Office Action (page 2, item 3), the Examiner rejected claim 32 under 35 USC §112, first paragraph. According to the Examiner's interpretation, the terms "A method step of plunging portions of the plate material around said end surfaces," recited in claim 32 does not have support in the original disclosure.

Applicant's Response:

As stated above, applicant has amended claim 32, herein. Upon careful consideration and in light of the above amendments, applicant respectfully traverses such rejection, and submits the rejection is overcome because several paragraphs (e.g., paragraphs [031], [122], [124] and [218]) of the originally filed specification and the drawing (Fig. 13) of the present application provide express support for the method step of "plunging" portions around said end faces..., as recited in

claim 32.

For example, applicant respectfully submits that paragraph [122] of the originally filed specification specifies that, “Therefore, as shown in FIG. 13, it is preferable that the central axis L1 of the probe 104 be displaced from the boundary line L2 between the end faces 1, 2 of the first protrusion 8 toward the advancing side. That is, the probe 104 is plunged into the abutting regions at a position displaced to the advancing side”.

For all of the foregoing reasons, applicant respectfully requests reconsideration and withdrawal of the rejection of claim 32 under 35 USC §112, first paragraph.

2. Additionally, in the Office Action (page 2, item 5), the Examiner rejected claim 32 under 35 USC §112, second paragraph. The Examiner alleges that it is unclear how the plate material can be plunged into end faces.

Applicant's Response:

As stated above, applicant has amended claim 32, herein. Upon careful consideration and in light of the above amendment, applicant respectfully traverses such rejection and submits that the rejection is overcome.

Specifically, claim 32 has been amended to particularly point out and distinctly claim the subject matter of the present invention.

For all of the foregoing reasons, applicant respectfully requests reconsideration and withdrawal of the rejection of claim 32 under 35 USC §112, second paragraph.

Claim Rejections – 35 USC §103

1. In the Office Action (page 3, item 7), the Examiner rejected claims 5-7 and 33 under 35 USC §103(a) as being unpatentable over Colligan et al. (US 5,794,835) (hereinafter “Colligan”)

in view of Boon et al. (US 6,325,273) (hereinafter “Boon”). In relation to independent claim 5, it is the Examiner’s position that: Colligan teaches all required features of the claimed friction stir welding process except for displacement of the probe; Boon teaches such a displacement of an FSW probe (plunging member); it would have been obvious to a person of ordinary skill in the art to include the probe and displacement thereof as taught by Boon in the method of Colligan to achieve the claimed friction stir welding process; while Boon does not teach the specific amount of displacement as claimed, this is an obvious matter of optimization; and Colligan teaches projecting fingers on a workpiece in his Fig. 3.

Applicant’s Response:

As stated above, applicant has amended claim 5, herein. Upon careful consideration and in light of the above amendments, applicant respectfully traverses such rejection and submits that the rejection is overcome for substantially the same reasons as discussed in Amendment-C of January 16, 2009 and Amendment-D of June 4, 2009, which are not overcome by additional teachings of Boon. Specifically, the deficiencies of Colligan – e.g., Colligan failing to disclose a workpiece plunging member being displaced from a boundary line between a first end face and a second end face to a second end within a range less than or equal to the radius of the workpiece plunging member, as required by independent claim 5 – are not overcome by the disclosure of Boon.

For example, Boon discloses a friction welding method for lap welding of lead sheets (or other softer materials such as thermoplastics) using a hardened steel tool (probe) 1 having a convex-shaped head 3 provided with one or more prongs/protrusions 2 (not a single plunging member with a substantially circular cross section as claimed), and a body region 4 adapted to fit into a rotating engine or a motor. According to the welding method of Boon, an upper lead sheet 6 is laid on a lower lead sheet 5 to form a lap joint. The lower sheet 5 is placed on a firm substrate. At the start of the welding process, the rotating probe 1 is

introduced slowly into the lead sheet, giving sufficient time for plasticizing to begin. The prongs 2 are fully penetrated into the uppermost sheet 6 and only partially penetrated into the lowermost sheet 5, whilst the head 3 of the probe causes a slight undercut into the upper lead sheet 6 by a distance t (col. 4, lines 40-64; Figs. 1 and 5).

According to the Boon's welding method, after having the rotating probe penetrated into both the sheets 5, 6, the probe 1 is arranged such that its axis of rotation is angled away from the plane perpendicular to the lead sheets 5, 6 by an angle "a" having a value of about $3^\circ \pm 2^\circ$. The probe 1 is then progressed in a direction at a speed V whilst maintaining a substantially constant downward force F . As the probe 1 moves forward, the plasticized matter behind the probe 1 sets and forms a joint between the two lead sheets 5, 6 in a joint region which follows the path of the probe 1 (col. 4, line 65 – col. 5, line 12; col. 9, lines 57-64; Figs. 1-2).

Thus, Boon fails to disclose end faces of a workpiece disposed in abutment with each other along a boundary line, and correspondingly also fails to disclose displacing a workpiece plunging member from any such boundary line between the first end face and the second end face to the second end within a range equal to or smaller than the radius of the workpiece plunging member, as required by claim 5. Accordingly, the Boon disclosure does not overcome the deficiencies of Colligan.

Based on such actual deficiencies of Boon, a person of ordinary skill in the art would not consider it obvious to include the probe and displacement thereof as taught by Boon in the method of Colligan, as proposed by the Examiner, to achieve the claimed friction stir welding process. Therefore the applied references, considered either singly or in combination, fails to disclose limitations of claim 5. Also, the applied references fail to disclose limitations of claims 6-7 and 33 for the reasons provided in relation to claim 5.

For all of the foregoing reasons, applicant respectfully requests reconsideration and

withdrawal of the rejection of claims 5-7 and 33 under 35 USC §103(a).

2. In the Office Action (page 5, item 8), the Examiner rejected claims 8, 9 and 34 under 35 USC §103(a) as being unpatentable over Urschel (US 2,148,714) (hereinafter “Urschel”) in view of Colligan. Again, it remains the Examiner’s position that it would have been obvious to persons skilled in the art to modify Urschels’ old-style (1939) hollow metal truss in relation to select aspects of Colligan’s FSW method to thereby (somehow) arrive at the claimed invention.

Applicant’s Response:

As stated above, applicant has amended claim 8, herein. Upon careful consideration and in light of the above amendments, applicant respectfully traverses such rejection for substantially the same reasons as discussed in Amendment-C filed on January 19, 2009 and Amendment-D of June 4, 2009, and submit that the rejection is overcome.

Moreover, in an effort to expedite the prosecution of the present application and to further define the claimed friction stir welding process over the applied references, as stated above, applicant has amended claim 8 herein.

Applicant respectfully submits that a total combination of each of claims 8, 9 and 34 is not taught or suggested in the references of record, considered either singly or in combination.

For all of the foregoing reasons, applicant respectfully requests reconsideration and withdrawal of rejection of claims 8, 9 and 34 under 35 USC §103(a).

3. In the Office Action (page 6, item 9), the Examiner rejected claims 1-2 under 35 USC §103(a) as being unpatentable over Colligan in view of Knauth et al. (US 2,740,877) (hereinafter “Knauth”). It is the Examiner’s position that while Colligan fails to disclose grippable protrusions on his workpiece, it would have been obvious to persons skilled in the art to modify Colligan’s

FSW method in relation to select aspects of Knauth's old-type (1959), horn-type seam welding apparatus to thereby (somehow) arrive at the claimed invention.

Applicant's Response:

As stated above, applicant has amended claim 1, herein. Upon careful consideration and in light of the above amendments, applicant respectfully traverses such rejection and submits that the rejection is overcome because deficiencies of Colligan are not overcome by additional teachings of Knauth , e.g., although Colligan discloses providing the run-on 12 and run-off 14 extensions for his workpieces, Colligan fails to disclose or suggest gripping the protrusions while friction-stir-welding abutting regions of the end faces of the plate material to join the end faces to each other, as recited in claim 1. Whereas, Knauth's welding apparatus appears to be applicable (only) for holding two flat workpieces and welding the two pieces together along a boundary between end surfaces thereof, and for seam welding pipes contrary to the FSW method of Colligan (and contrary to the claimed FSW method).

For example, Knauth discloses the welding apparatus 10 including a base 11, an upright supporting column 12, a horizontal horn assembly 14 supported by column 12, a pair of parallel, horizontal triangular-shaped arm elements 15 supported by column 12, clamping finger 17 supported by the arm elements 15, parallel rails 18 supported by the arm elements 15, and a welding unit 20 which moves on the parallel rails 18 in a reciprocating path. The horn assembly 14 is located below the arm elements 15 (col. 3, lines 16-27).

According to the Knauth disclosure, during welding operation, a pair of workpieces 94, 98 is gripped between respective workpiece engaging plates 95, 95 of the horn assembly 14 and clamping fingers 17; end faces of the workpieces are abutted; and an electrode 21 of the welding machine travels along a boundary line between the end faces of the workpieces 94, 98 (col.5, line 16 – col.6, line 13, Figs. 3-5).

Thus, Knauth fails to disclose the method step of gripping the protrusions by a gripping member, as recited in claim 1. Rather Knauth discloses gripping the entire length or width of workpieces members at end portions thereof for bringing the end faces thereof in abutment, and welding the workpieces together along the abutment.

Accordingly, a person of ordinary skill in the art would not consider it obvious to modify the Colligan's welding method by incorporating Knauth's butt welding process in which two sheets or two pipes are gripped using clamping fingers 17, 17, and workpiece engaging plates 95, 95 of the horn assembly 14, as proposed by the Examiner because according to Knauth's actual disclosure the two sheets / tubular workpieces are gripped along an entire length/depth thereof, and are not gripped at protrusions (as required by the claimed method).

More significantly, Knauth's welding apparatus does not include gripping members for gripping the protrusions projecting along the end faces of the fingers of a hollow cylindrical body, as required by claim 1. Also, the circular cross-section of the horn assembly is not adapted for gripping the protrusions of a hollow cylinder body.

Further, even if, for the sake of argument, the Colligan's welding method is modified by including features of the Knauth welding method, e.g., gripping two pipes using clamping fingers 17 and the workpiece engaging plates 95, 95 of the horn assembly 14, as proposed by the Examiner, such hypothetical welding method would not include gripping the protrusions by the gripping member, as required by the claimed invention because the two cylinders arranged side-by-side would not have the protrusion projecting along a joining direction thereof. Knauth's method does not require protrusions projecting along the joining direction between two metal sheets or between two cylindrical pipes.

Alternatively, even if, for the sake or argument, Colligan's plates 1A, 1B in their abutted position are held in the welding apparatus of Knauth, runoffs 12, 14 (which the Examiner's

alleges being protrusions) of Colligan's plates 1A, 1B cannot be gripped by Knauth's clamping fingers 17 and the workpiece engaging plates 95, 95 of the horn assembly 14 due to constructional features thereof, as discussed above.

Also, due to features of the clamping fingers 17 and the workpiece engaging plates 95, 95 of the horn assembly 14 of Knauth, the protrusions (if any), which may be formed on a hollow cylindrical body formed by bringing end faces of the plate material, cannot be gripped by Knauth's clamping fingers 17 and the workpiece engaging plates 95, 95, since the workpiece gripping structure of Knauth is configured to grip metal sheets arranged side-by-side.

Thus, the proposed combination of the applied references fail to disclose the claimed method of manufacturing a hollow cylindrical body requiring performing the method steps forming a hollow cylindrical body and forming protrusions by bringing end faces of a plate material having fingers projecting from corners along a joining direction, gripping said protrusions by a gripping member, while the protrusions are gripped in place, friction-stir-welding abutting regions of the end faces of the plate material to join the end faces to each other, thereby forming a hollow cylindrical body, as required by claim 1.

Also, the proposed combination of the applied references fails to disclose features of claim 2, for the reasons provided in relation to claim 1. Further, the Examiner appears to be misinterpreting claim 2 in the Office Action by alleging that Colligan in view of Knauth teaches a hollow cylindrical body having the protrusions that are pressed from a side of an outer circumferential wall thereof. Such limitations are not defined in claim 2. Rather, claim 2 specifies that hollow cylindrical body (having said protrusions) is pressed from a side of an outer circumferential wall surface thereof when the abutting regions are friction-stir-welded.

For all of the foregoing reasons, applicant respectfully requests reconsideration and withdrawal of rejection of claims 1-2 under 35 USC §103(a).

4. In the Office Action (page 7, item 10), the Examiner has rejected claim 3 under 35 USC §103(a) as being unpatentable over Colligan in view of Knauth and further in view of Cleveland et al. (US 2002/0020164 (herein after “Cleveland”).

Applicant’s Response:

Upon careful review of the disclosure of Cleveland, applicant respectfully disagrees with the Examiner’s rejection of claim 3 for the reasons provided in relation to claim 1, hereinabove, which are not overcome by additional teachings of Cleveland, and for the reasons discussed below.

For example, Cleveland discloses an embodiment of a tubular body portion 102-1 having a varied shape or profile dimension along a length thereof. An outer diameter 152 and inner diameter 154 of tubular body portion 102-1 have a varied or changing cross-section along a length thereof. The varied dimension of the tubular body portion 102-1 is formed from a contoured or shaped workpiece 106-3 having free-formed features 104 thereon (paragraph [0026]; Figs.7-2, 8-1 and 8-2).

Accordingly, Cleveland fails to disclose that the abutting regions are friction-stir-welded while said hollow cylindrical body is inclined with respect to a horizontal direction, as recited in claim 3. Rather, Cleveland discloses welding a tapered tubular body.

For all of the foregoing reasons, applicant respectfully requests reconsideration and withdrawal of rejection of claim 3 under 35 USC §103(a).

5. In the Office Action (page 8, item 11), the Examiner has again rejected claim 4 under 35 USC §103(a) as being unpatentable over Colligan in view of Knauth and further in view of Lawrence (WO 99/33594) (herein after “Lawrence”).

Applicant's Response:

Upon careful review of the disclosure of Lawrence, applicant respectfully disagrees with the Examiner's rejection of claim 4 for the reasons provided in relation to claim 1, hereinabove, which are not overcome by additional teachings of Lawrence.

For all of the foregoing reasons, applicant respectfully requests reconsideration and withdrawal of rejection of claim 4 under 35 USC §103(a).

6. In the Office Action (page 6, item 3), the Examiner has again rejected claim 32 under 35 USC §103(a) as being unpatentable over Colligan in view of Knauth and further in view of Boon.

Applicant's Response:

As stated above, application has amended claim 32, herein. Upon careful consideration and in light of the above amendments, applicant respectfully traverses such rejection and submits that the rejection is overcome for the reasons provided in relation to claim 1, hereinabove, which are not overcome by additional teachings of Knauth and/or Boon (discussed in relation to rejection of claim 5, hereinabove).

For all of the foregoing reasons, applicant respectfully requests reconsideration and withdrawal of rejection of claim 32 under 35 USC §103(a).

Other Matters

New claims 35-36 are believed to patentably distinct over the references of record for the reasons provided in relation to claims 1 and 8, respectively, hereinabove.

Conclusion

In conclusion, based on all of the foregoing, applicant respectfully submits that all of the objections and rejections set forth in the Office Action are overcome, and that as presently

amended, all of the pending claims are believed to be allowable over all of the references of record, whether considered singly or in combination.

Applicant requests reconsideration and withdrawal of the rejection of record, and allowance of the pending claims.

If the Examiner is not fully convinced of the allowability of all of the claims now in the application, applicant respectfully requests that the Examiner telephonically contact applicant's undersigned representative to expeditiously resolve prosecution of the application.

Favorable reconsideration is respectfully requested.

Respectfully submitted,



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